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Northern North Atlantic oceanic conditions as an important driving factor for forest fire activity in northern Scandinavia

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The North Atlantic is a major source of heat and moisture to Northern Scandinavia, hence the state of the North Atlantic Ocean circulation is important for the anomalies in the boreal fire activity. Modelling studies by Born & Stocker (2014) demonstrated a possible bi-stability of the subpolar gyre and associated effects on the regional atmospheric and oceanic heat and moisture flux anomalies in the entire northern North Atlantic realm. Furthermore, a model study by Moreno-Chamarro et al. (2017) shows a link between a reduction in the vigour of the subpolar gyre, preferential zonal atmospheric circulation in the northern North Atlantic and the increased frequency of atmospheric blocking events over Scandinavia favourable for creating and sustaining regional droughts.

Using a forced GCM simulation of the MPI-ESM for climate of the last millennium, we demonstrate a relationship between the subpolar North Atlantic oceanic conditions, in particular the state of the subpolar gyre, the temperature and precipitation conditions during Winter, and the Monthly Drought Code (Girardin & Wotton, 2009) used in the Scandinavian study area as an indicator for Summer fire activity over the past millennium.

The existing proxy-evidence for an increased number of forest fires during the peak of the Little Ice Age (Drobyshev et al. 2016) do not correspond to exceptionally dry Summers in the model run as reflected by the monthly drought code. We hypothesise that a majority of these fires may have occurred during Winter, which were cold and dry during the Little Ice Age.

In the model run, significantly weaker subpolar gyre circulation is observed during winters preceding dry Summers in Scandinavia. The weak oceanic circulation is associated with positive sea surface temperature anomalies in the gyre region, and increased heat flux from the ocean to the atmosphere. Atmospheric circulation anomalies extending up to at least the tropospheric polar jet stream (300 hectopascal) are observed during late Winter and Spring, and stationary high-pressure systems persist over northern Scandinavia during the late Spring and Summer. However, additional experiments and analyses are needed to better understand the nature of the inter-seasonal delay and precise physical mechanisms for the ocean-atmosphere coupling.

References:
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